3GPP TSG-RAN WG2 Meeting #116 Electronic R2-211xxxx

**Online, 1st – 12th November, 2021**

**Agenda item: 8.15.2**

**Source: NEC**

**Title: [AT116-e][704][V2X/SL] Need of additional new considerations (NEC)**

**WID/SID: NR\_SL\_enh-Core - Release 17**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following email discussion:

* [AT116-e][704][V2X/SL] Need of additional new considerations (NEC)

**Scope:** Discuss the need of additional new aspects proposed in P1/R2-2109722, P4/R2-2109812, P1/R2-2109937, P1/R2-2110062, P12/R2-2110155, P8/R2-2110938, P1-P2/R2-2111119, and possible solutions if the need is agreed.

**Intended outcome:** Discussion summary in R2-2111421

**Deadline:** 11/8, 17:00 UTC

# 2 Summary of proposals in contributions

This email discussion is to summarize the Tdocs and proposals listed below with an intention to come up with a list of proposals that are agreeable during the related online discussion.

|  |  |
| --- | --- |
| Tdoc# | Proposals |
| [R2-2109722](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109722.zip) | Proposal 1 RAN2 to discuss to introduce a new MAC CE to indicate DRX operation suspend/resume. |
| [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip) | Proposal 4: RAN2 to consider the SL DRX configuration for SL groupcast may include one or more settings for the SL DRX ON duration, allowing a SL group to (re)select setting for the SL DRX ON duration for a given SL DRX cycle. |
| [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) | Proposal 1: RAN2 to define the inactivity timer maintenance rules for groupcast transmissions with MCR |
| [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip) | Proposal 1 RX UE filtering based on SL-DRX shall not be specified and enforced. RX UE is allowed to receive and process incoming traffic which does not exactly match SL DRX configurations. |
| [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip) | Proposal 12. The solution to avoid the wrong HARQ combining due to DTX case in SL DRX operation should be discussed in RAN2. |
| [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip) | Proposal 5: For GC, number of group members needs to be considered in the determination of SL DRX on-duration and inactivity timers in the scenario where the UE knows it. |
| [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip) | Proposal 1: An SL UE capability, representing the amount of time a UE needs to process SL grant and prepare data transmission, may be indicated by the UE to its serving gNB.  Proposal 2: In addition to SL RX UE’s assistance information, SL traffic characteristics and associated QoS requirement are also indicated to the SL TX UE’s gNB for determining SL DRX On duration. |

Rapporteur would like to encourage companies especially the proponents of the above (and other, if any) potential solutions to comment and explain more on motivations if the rapporteur’s summary of each proposal is insufficient.

# 3 Discussion

Since contributions/proposals have a wild variety, so we discuss them one by one.

## 3.1 [R2-2109722](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109722.zip) P1

[R2-2109722](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109722.zip) focused on the following scenarios and discussed the DRX suspend/resume mechanism.

1. a RX-UE is involved into more than two SL unicast communications in which individual TX-UEs deliver contradictory DRX configurations
2. a RX-UE is involved into SL unicast and groupcast/broadcast communication having contradictory DRX configurations

For simplification, we only show Figure 2 of scenario (2) here. The contribution proposed

**Proposal 1 RAN2 to discuss to introduce a new MAC CE to indicate DRX operation suspend/resume.**

Procedure with DRX operation suspend/resume indication is illustrated in Fig.3.



Figure 2 A RX-UE is involved into SL unicast and groupcast/broadcast communication having contradictory DRX configurations



Fig.3. Procedure with DRX operation suspend/resume indication

**Question 1:** As stated in the contribution, when the RX-UE cann’t harmonize DRX configuration 1 and 2 to find out a compromised configuration (e.g., from Uu and sidelink DRX configuration alignment pespectives), the only thing RX-UE can do is to quit from sidelink DRX operation and monitor PSCCH continuesly. Do companies agree with the above observation?

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| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | No | If there are multiple DRX configurations which are not overlapping, it can be either due to bad configuration or it is infeasible to enable DRX.  In our mind, how to align DRX configurations can be up to TX UE’s gNB or TX UE implementation. No further enhancement is needed in this release. |
| InterDigital | No | So far, we have assumed TX/RX UE implementation for determining assistance information and DRX configuration determination for unicast. This proposal contradicts that approach. |
| Apple | Yes with comment | We do not think the DRX configurations are “contradictory”, it is just bad configurations which make UE stay awake for unnecessarily longer time. But this is the consequence of Tx-centric SL-DRX design and the approach of allowing per-link, or per-cast-type DRX configurations. We are not sure this can be avoided if we do not change the SL DRX design fundamentally. |
| Xiaomi | No | We think the scenario is valid, which is RX UE may not be able to derive one set of DRX configuration to cover Uu DRX and SL DRX on other links. However, we prefer RX UE to provide multiple set of desired DRX configuration in this case. TX UE can select any set of DRX configuration indicated by remote UE. |
| OPPO | No | Firstly, if the desired SL DRX is changed, Rx UE can always send assistance information to Tx UE, i.e. no new signalling is needed to indicate the desired SL DRX changing.  Therefore, we fail to see the need for this new signalling. |
| Nokia | No | The RX-UE can indicate its preferred SL DRX configuration to multiple TX-UEs in the provided assistance information message. The alignment is up to TX-UE or gNB. No further enhancement is needed for Rel-17. |
| LG | No | Agree with Ericsson |
| Qualcomm | No | Rx UE can always consider all the sidelink communications that it participates in and provide preferred SL DRX configuration to Tx UE or forwarded by Tx UE to gNB and Tx UE or gNB may decide a suitable SL DRX configuration based on Rx UE’s input. There may be sometimes that multiple SL DRXs may not be fully overlapped with the On duration (e.g., with different SL DRX cycle lengths) or not fully aligned with the Uu DRX, and a UE has to operate with more than one SL DRXs which is still better than operating without SL DRX (i.e. suspended). |
| Intel | No | Agree with InterDigital that so far, we have relied on the assumption that it is implicitly handled by TX/RX UE implementation, so not sure why we need to change that. We are also not sure if there is a need for this optimization considering the limited time for this WI |
| Spreadtrum | No | We don’t think the RX-UE should quit from sidelink DRX operation due to non-overlapping DRX configurations. Instead, the Rx UE can send assistance information to Tx UE and the alignment can be up to Tx UE implementation. |
| Lenovo | No | Share the view with other companies, that “contradictory” configuration is rather a “bad” or “non-overlapping” DRX configuration. Firstly, when Tx UE configure SL DRX, it will consider other SL DRX configuration based on assistance information, secondly if SL DRX configuration is not suitable, the configuration can be updated by communicate assistance information to Tx UE/gNB. so we do not think this is an issue |
| ASUSTeK | No | Agree with Ericsson. |
| vivo | No | The issue can exist. But we don’t think the RX UE behavior is correct. Since RAN2 has adopted TX centric mechanism for SL DRX configuration, whether the RX would quit from sidelink DRX operation should be guided by TX UE. The only thing RX UE can do is to reject the SL DRX configuration from TX UE and send SL DRX assistance information to renegotiate the SL DRX configuration. |
| NEC(proponent) | Yes | With the TX-UE centric SL DRX configuration determination, the DRX configuration delivered via *RRCConfigurationSidelink* from TX-UE to RX-UE is mainly based on the information known as TX-UE (e.g., traffic pattern, QoS requirements). Therefore multiple TX-UEs may inform non-overlapping DRX configuration to a single RX-UE. In results in that the RX UE can’t derive its desired DRX confirmation at all. |
| CATT | No | For the Tx-centric SL DRX configuration model, Rx UE will provide desired SL DRX configuration to Tx UE. When Rx UE provides the desired SL DRX configuration, it should consider the SL DRX configuration alignment of Uu DRX, SL DRX of different PC5-S unicast connections and SL DRX of BG/CG. Hence, in most case, the DRX configuration should be aligned, not contradictory. |

**Question 2:** As stated in the contribution, in the above case, a DRX configuration suspend/resume indication from RX-UE to TX-UE illustrated in Fig.3 is beneficial for optimization of both QoS (i.e., service performance) and power saving performance. Do companies agree with the above observation? If companies have other pontential solutions in their mind, please state them in the Comments column.

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | No | If there are multiple DRX configurations which are not overlapping, it can be either due to bad configuration or it is infeasible to enable DRX.  In our mind, how to align DRX configurations can be up to TX UE’s gNB or TX UE implementation. No further enhancement is needed in this release. |
| InterDigital | No | So far, we have assumed TX/RX UE implementation for determining assistance information and DRX configuration determination for unicast. This proposal contradicts that approach. |
| Apple | See comment | Allowing RX-centric approach for DRX configuration may help to solve the problem better than the remedy provided by resume/suspend. Maybe we can revisit this issue in R18 and check how to solve it in a best way. |
| Xiaomi | No | As commented in Q1. |
| OPPO | No | For power saving aspect, the designed assistance information from Rx is already a tool, so no need for further optimization;  For QoS aspect, the SL DRX configuration already takes QoS into consideration, i.e. the QoS can be ensured with SL DRX operation.  Therefore, we don’t agree with the above observation. |
| Nokia | No | Same as Q1 |
| LG | No |  |
| Qualcomm | No | Operating with more than one SL DRXs 9not overlapped) still saves some power than suspending an SL DRX without low power state. |
| Intel | Maybe not | Maybe there can be some benefit for this optimization, but we are unsure if it is worth discussing at this stage. |
| Spreadtrum | No | Same comments as in Q1. |
| Lenovo | No | SL DRX configuration can be updated by further assistance information if not suitable, and current scheme for SL DRX configuration alignment is enough |
| ASUSTeK | No |  |
| vivo | No | As illustrated in Q1, rely on PC5 RRC singnalling procedure is enough. No need for a new MAC CE to suspend/resume indication from RX-UE to TX-UE. For example, the RX UE can reject the SL DRX configuration from TX UE and send SL DRX assistance information to renegotiate the SL DRX configuration. It is up to TX UE whether to send updated SL DRX configuration. If no updated SL DRX configuration or release of existing SL DRX configuration is indicated via PC5 RRC Reconfiguration, the RX then quits from sidelink DRX operation as a consequence. |
| NEC(proponent) | Yes | On the top of TX-UE centric SL DRX configuration determination, an RX-UE centric suspend/resume mechanism would be beneficial and helpful. One more thing is that we just agreed the following at RAN2#116-e meeting. |
| CATT | No | See the comment in Q1. |

**Question 3:** If the answer of Question 2 is “Yes”, the next issue is how to send the DRX configuration suspend/resume indication from RX-UE to TX-UE. Do companies agree with P1 to introduce a new MAC CE? If companies have other pontential solutions in their mind, please state them in the Comments column.

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| --- | --- | --- |
| Company | Responses | Comments |
| NEC(proponent) | Yes | As the proponent, we think a new MAC CE is a simple solution to address the issue. |
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## 3.2 [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip) P4

------Quote from [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip)-----

## Congestion issue related to SL DRX configuration

### SL groupcast

It has been agreed in RAN2 that the SL DRX configuration including SL DRX cycle and ON duration for SL groupcast is per QoS profile of the SL groupcast. This means that different SL groups, regardless of the group size or traffic demands aggregated from all Tx UE members of a SL group during the SL DRX ON duration of a given SL DRX cycle, may have the same SL DRX configuration. On the one hand, the SL DRX configuration with the SL DRX ON duration as short as possible is preferred from the power saving perspective. On the other hand, as the need for SL transmissions of a SL group for SL groupcast may vary from one SL DRX cycle to another SL DRX cycle depending on, e.g., how many UE members of the SL group and how much each of these UE members need to transmit to the SL group in a given SL DRX cycle, the shorter the SL DRX ON duration the higher the congestion is for the SL group. The congestion here may include possible collisions of SL transmissions from different UE members of the SL group, either with each other within the SL group or with other UEs in proximity outside the SL group. This is caused by using the same or at least overlapping time-frequency resources for the SL transmissions. The half-duplex issue within the SL group that different UE members of the SL group transmit to the SL group simultaneously and miss to receive each other transmissions may be considered as part of the congestion. Therefore, the SL DRX configuration for SL groupcast may need to be adaptable to cope with the congestion issue specific to a SL group while maximizing power saving for the SL group. One option is to have the SL DRX configuration per QoS profile, as agreed so far in RAN2, but with one or more settings for the SL DRX ON duration, allowing a SL group to (re)select setting for the SL DRX ON duration for a given SL DRX cycle.

**Proposal 4:** RAN2 to consider the SL DRX configuration for SL groupcast may include one or more settings for the SL DRX ON duration, allowing a SL group to (re)select setting for the SL DRX ON duration for a given SL DRX cycle.

------Quote from [R2-2109812](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109812.zip)-----

**Question 4:** Do companies agree with P4 to include one or more settings for the SL DRX ON duration in SL DRX configuration for SL groupcast? If companies have other pontential solutions in their mind, please state them in the Comments column.

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | No | Allowing multiple settings of ON duration in the SL DRX configuration, would cause additional design efforts for RAN2.  The issue elaborated is relevant, however it can be categorized as optimization issue. No need to address it in Rel-17 given RAN2 has limited time. |
| InterDigital | Yes | We think congestion is an issue if SL DRX configuration may be such that on duration is short and may affect QoS of even transmissions on SL which are not associated with DRX.  A CBR-dependant on duration for groupcast would be a simple approach to resolve this issue. |
| Apple | No | onDuration length is not critical in this case. If there are many SL senders in nearby, then the chance to receiving something in the onDuration and start the inactivity timer is also higher. |
| Xiaomi | No | It’s unclear how the on duration is selected. The number of member may not be available for some group. Furthermore, inactivity timer is supported for groupcast. Inactivity timer could extend the active time and provide additional transmission opportunities, which could ease the potential congestion caused by large number of members. |
| OPPO | No | This will cause misalignment of DRC cycle between group members since there is no PC5-RRC connection in groupcast. |
| Nokia (proponent) | Yes | As we have argued in section 2.3 of our paper R2-2109812 SL DRX configuration may create congestion problems since multiple UEs need to squeeze their transmissions/receptions into a small active time period (and close to zero congestion due to no sidelink traffic in the long inactive periods). Especially for groupcast a further freedom to select the on duration based on CBR can eliminate the congestion problem easily. |
| LG | No | Same view with Ericsson. The proposal would cause additional design efforts for RAN2. This kind of optimization is not needed. |
| Qualcomm | No | Not clear how the On duration is selected and activated. This is further optimization to On duration which may be replaced by enabling Inactivity timer. |
| Intel | No | Considering that group management operation in general is not visible at the AS layer, this level of optimization, i.e. increased granularity for SL DRX configuration beyond QoS profile to cater to different group sizes does not seem essential. |
| Spreadtrum | No | It is an optimization since On duration can be extended by inactivity timer. |
| Lenovo | Yes for congestion issue | We think congestion issue exist for groupcast, but even with several on duration values, still the congestion may happens according to our analysis in R2-2109724. Other solution e.g., one or more retransmissions at randomly distributed transmission opportunities may needed. |
| ASUSTeK | No | We think no further optimization on on-duration is needed for SL groupcast, as it causes further spec effort and may lead to more group UE overhead on synchronizing DRX cycle with other group members in the face of varying channel condition. |
| vivo | No | Agree with Apple, the on-duration can be extended. |
| NEC | No | Agree with Apple that onDuration length is not critical in this case. We also think this makes DRX function complicated unnecessarily just for optimization. |
| CATT | No | Since SL DRX inactivity timer is supported for SL groupcast, SL active time can be extended based on requirement, hence P4 had better not considered. |

## 3.3 [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) P1

------Quote from [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) -----

## SL DRX Timers

Details for the inactivity timer have, for the most part, been addressed by RAN2. Another groupcast specific issue related to the inactivity timer is the handling of transmissions with MCR. In NR V2X, transmissions outside of the MCR are assumed to be treated as best effort by the system (e.g. RX UE sends HARQ feedback only when it is within the MCR). Along the same lines, whether an RX UE should consider receptions where it is outside the MCR when deciding whether to (re)start the inactivity timer should be further discussed by RAN2. From a power savings perspective, there may be no benefit in restarting the inactivity timer when the UE is outside the MCR for a transmission. On the other hand, the UE may quickly fall within the MCR of additional transmissions after this if the UE is moving. A safer approach may therefore be to allow the UE to ignore transmissions with respect to resetting of the inactivity timer only when the UE is well outside the MCR.

Proposal 1: ***RAN2 to define the inactivity timer maintenance rules for groupcast transmissions with MCR***

------Quote from [R2-2109937](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2109937.zip) -----

**Question 5:** Do companies agree with P1 to define the inactivity timer maintenance rules for groupcast transmissions with MCR?

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| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | No | The issue elaborated is relevant, however it can be categorized as optimization issue. No need to address it in Rel-17 given RAN2 has limited time. |
| InterDigital | Yes | We think everything is already in place (distance determination, MCR indication in SCI, etc) for the RX UE to consider MCR in its timer maintenance. It would also lead to considerable power savings for groupcast, which should be the focus of this release. |
| Apple | Yes | I think this is a legitimate issue to be solved as range-based GC is supported in NR SL. |
| Xiaomi | No | UE may move from outside of range to insided of range. It’s safer for UE to restart inactivity timer regardless of MCR. Otherwise, after moving to inside of range, UE may lose the data due to not extending the active time when it was outside of range. |
| OPPO | No | We understand the baseline scheme (based on agreement so far) is the UE should determine whether to start the inactivity timer based on tx-profile of the interested service, i.e. if it is interested in the service and it is indicated by tx-profile to use DRX, it should start inactivity timer. We have not identified a key/critical issue that requires more solution beyond the baseline scheme.  Furthermore, if this MCR based scheme is introduced, due to the mobility, we foresee even more left issue as side-effect, e.g., how for Tx UE to derive the active time based on the inactivity timer if some of the inactivity timer restarting operation would take effect yet the others would not?  So no additional rules are needed. |
| Nokia | Yes | We agree with InterDigital (proponent) and Apple view, as MCR is already in place for groupcast since Rel-16. So it seems obvious to allow the RX-UE to make a range-based decision whether to prolong its active time i.e. start inactivity timer or not. |
| LG | Yes | Same view with Interdigital. |
| Qualcomm | No  (UE implementation) | An Rx UE may decide to start its Inactivity timer or not based on the MCR for connectionless groupcast, e.g., starting Inactivity timer if within the MCR or very close to the MCR boundary due to mobility consideration. But this can be UE implementation without specifying a certain behaviour since Tx UE is not aware of the Rx UE(s) till receiving a NACK. |
| Intel | No | The fundamental assumption that transmissions outside the MCR should somehow be treated as low priority for the purpose of restarting the inactivity timer is not one that we think is that straightforward, especially considering the mobile nature of UEs. So, we don’t think such an arbitrary restriction is needed. |
| Spreadtrum | No | Agree with the rapporteur that the UE may move into the range quickly and it’s safer to start inactivity timer regardless of MCR. |
| Lenovo | No | Inter-UE range may change dynamically, e.g. a UE outside of range could be inside the range and require to receive the data. In this case, if UE do not maintain the inactivity timer when outside the range, UE may miss the data when entering the range. |
| ASUSTeK | No | We think SL DRX optimization regarding MCR is not needed at least in this release. |
| vivo | No | The MCR based inactivity timer handling is just optimization for UE power saving, but with potential packet loss due to UE mobility. We don’t see the significance to introduce such MCR based mechanism. |
| NEC | No | Same view with OPPO. |
| CATT | No | Although this mechanism is benefit for power saving, but if this mechanism is supported and the UE out of MCR ignore transmissions with respect to resetting of the inactivity timer, it may result that reception loss of the Rx UE which will impact the Rx UE experience, it is not best effort. |

**Question 6:** If the answer of Question 4 is “yes”, what is the preferred rule? Please provide details in the following table.

|  |  |
| --- | --- |
| Company | Comments |
| InterDigital | Inactivity timer associated to groupcast is (re)started only when the groupcast transmission received by the RX UE is within the MCR (or MCR plus a configured offset). |
| Apple | The UE is not supposed to start or restart its inactivity timer if it is not the intended in-range receiver. |
| Nokia | Up to RX-UE implementation |
| LG | Same solution with InterDigital and Apple.  Inactivity timer associated to groupcast is (re)started only when the groupcast transmission received by the RX UE is within the MCR. |
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## 3.4 [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip) P1

-----Quote from [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip)-----

## 2.1 Traffic filtering based on SL DRX configuration in RX UE

SL DRX is not designed as legacy Uu to have one SL DRX configuration per MAC. Instead, there are multiple active SL DRX configurations supported by a single UE. If a UE supports different cast-types, there are different SL DRX configurations for each cast type. If a UE communicates with multiple peer UEs, then there are different SL DRX configurations for each of those peer UE. Each of these SL DRX configurations is also associated with its own drx-inactivity timer. Hence, the overall DRX ACTIVE time is made up of each of those “exclusive DRX active periods” which is configured separately.

**Observation 1 The overall RX UE DRX Active time in SL interface is the union superset of individual active periods created by individual exclusive SL DRX configurations.**

Therefore, from an RX UE perspective, instead of receiving any traffic in which the RX UE is interested at any DRX active time, the RX UE could filter incoming traffic based on the “exclusivity“ of SL DRX configuration.

For example, in each of “exclusive DRX active period”, the UE can

1. Decode SCI cast type, and only continue to decode TB if the cast-type matches the cast-type associated with SL DRX configuration(s) of the current active period.
2. Decode the MAC address and only pass the received packet to upper layer if the destination address or <src, dst> address pair matches the address(es) associated with current SL DRX configuration(s) of the current active period.

The above RX UE filtering behavior assumes that sender will always precisely track the active time of a receiver according to SL-DRX configuration(s). However, different from Uu interface, this kind of tracking is proven to be difficult if communication involves multiple parties. TX UE may not always track and follow RX UE’s SL DRX. For example:

1. SL groupcast may involve multiple sender and multiple receiver, and not all the transmissions are correctly received by all group members. So, the DRX ACTIVE time of a particular group member UE is not always in sync among other group members.
2. Mode 1 UE may be allocated SL grants (DG or CG) which are not in sync with SL DRX active time of the SL destinations, as it is hard to sync among three-party <TX UE, RX UE, gNB> on-the-fly without introducing heavy Uu and SL RRC signaling overhead. So, occasionally, TX UE may need to use the SL grant in a time which does not match DRX of RX UE. This could also be true for mode 2 TX UE because resource selection will be more challenging when SL-DRX in RX UE is considered.

**Observation 2 RX UE filtering with SL DRX is based on ideal assumption that TX UE will always track DRX ACTIVE time of RX UE(s) precisely, but that put an overly restrictive requirement for TX UE implementation and resource usage.**

If RX UE enforces packet filtering based on SL DRX configuration, then occasional “outlier” traffic which does not match SL DRX configuration will be dropped by RX UE. That will hurt both latency and reliability performance, from the perspective of QoS. Also, this filtering behavior provides little benefits to RX UE power saving because RX UE has already decoded PSCCH and/or PSSCH for this slot. Anyway, the overall sidelink DRX ACTIVE time for a RX UE is always a superset of “exclusive DRX active periods” and would like to be longer than each TX UE is configured to be known. While TX UE tries its best to follow its perceived DRX active time of RX UE, RX UE shall be more forgiving on this aspect so that the overall system performance is not unnecessarily impacted. Thus, we propose:

**Proposal 1 RX UE filtering based on SL-DRX shall not be specified and enforced. RX UE is allowed to receive and process incoming traffic which does not exactly match SL DRX configurations.**

-----Quote from [R2-2110062](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110062.zip)-----

**Question 7** Do companies agree with Observation 1 “ The overall RX UE DRX Active time in SL interface is the union superset of individual active periods created by individual exclusive SL DRX configurations”?

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| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | Yes |  |
| InterDigital | Yes | In our view, this is the understanding in RAN2 so far on how the RX UE handles PSCCH monitoring under the assumption of multiple DRX configurations. |
| Apple | Yes | It is clear that a Sidelink UE needs to manage multiple DRX configurations from different destinations and different cast-types. |
| Xiaomi | Yes |  |
| OPPO | Yes |  |
| Nokia | Yes |  |
| LG | Yes |  |
| Qualcomm | Yes | Rx UE should not filter a packet with different L2 destination ID comparing with the current SL DRX’s L2 destination ID, since an SL DRX’s active state may be extended by Inactivity timer or HARQ retransmission timer where the extension may overlap with the next SL DRX active time. |
| Intel | Yes |  |
| Spreadtrum | Yes |  |
| Lenovo | Yes |  |
| ASUSTeK | Yes |  |
| vivo | Yes |  |
| NEC | Yes | When multiple Tx-UEs inform non-overlap SL DRX configuration to a single RX-UE, the overall RX UE DRX Active time would be all slots, i.e., RX-UE has to monitor PSCCH continuously. |
| CATT | Yes |  |

**Question 8** Do companies agree with Observation 2 “RX UE filtering with SL DRX is based on ideal assumption that TX UE will always track DRX ACTIVE time of RX UE(s) precisely, but that put an overly restrictive requirement for TX UE implementation and resource usage**.**”?

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| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | Yes |  |
| InterDigital | Yes |  |
| Apple | Yes |  |
| Xiaomi | Yes |  |
| OPPO | See comments | We don’t think we have the restriction on “Rx UE filtering based on SL -DRX only match SL DRX configurations”, but we agree that we will not specify such restriction. |
| Nokia | Yes |  |
| LG | Yes |  |
| Qualcomm | Yes |  |
| Intel | Partially agree | We agree with the first part, but we do not think this is any more restrictive implementation than other typical scenarios. Perhaps it is more prone to errors than the Uu case, but at the end of the day, the TX UE shall maintain the DRX timers as per specification |
| Spreadtrum | Yes |  |
| Lenovo | Yes |  |
| ASUSTeK | Partially agree | Agree with Intel. |
| vivo | Yes |  |
| NEC | Yes |  |
| CATT | Yes |  |

**Question 9** Do companies agree with Proposal 1 “RX UE filtering based on SL-DRX shall not be specified and enforced. RX UE is allowed to receive and process incoming traffic which does not exactly match SL DRX configurations.”?

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | Yes | Share the same understanding as in this paper. We shall focus on the core functionalities, rather than optimization. |
| InterDigital | Yes | We see no power savings benefit in performing filtering by L2 ID. And it further restricts resource usage, as pointed out by the paper. |
| Apple | Yes |  |
| Xiaomi | Yes | We think the proposal aligns the current design. No spec impact is foreseen. |
| OPPO | See comments | We agree with the intention, but we don’t see the need for this proposal as an agreement simply because there is no conclusion like “RX UE filtering based on SL-DRX” to revert. |
| Nokia | Yes |  |
| LG | See comments | Before making an agreement related to the proposal, when the RX UE receives a packet that is related to different SL DRX configuration (e.g., different SL DRX active time) within SL DRX active time, it should be clarified how to handle the SL DRX timer related to the packet. |
| Qualcomm | Yes | The extension via inactivity timer or HARQ retransmission timer of a first SL DRX may overlap with the active time of a second SL DRX. Therefore, such Rx UE’s filtering should not be specified. |
| Intel | See comment | We are not clear what proposal 1 means for RX UE operation. In our understanding, what is being proposed should already be permitted sine there is no restriction for any filtering of packets received during active time. It is not clear how the current specification somehow has this restriction, so it is not clear what specification change is needed based on this proposal. |
| Spreadtrum | Yes |  |
| Lenovo | See comments | Although we share the view that do not include further optimization in this release, but also have the concern that if Rx UE process the packet out of active time of corresponding SL DRX configuration, DRX timers e.g. inactivity timer, RTT/retx timer will be triggered unnecessary and reduce the power saving gain |
| ASUSTeK | Yes | No restriction on filtering is needed. |
| vivo | Yes | We want to confirm that there is also no specification impact on the 2nd sentence of proposal 1. |
| NEC | Yes | We understand this is already possible in the current spec and thus no change is needed. |
| CATT | Yes |  |

## 3.5 [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip) P12

----Quote from [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip)----

## 2.7 HARQ combining & SL DRX

If Rx UE performs HARQ combining under SL DRX operation, there could be a case where Rx UE performs combining the different packets, so that the decoding performance is degraded. In groupcast option 2 (NACK-only HARQ feedback mode), when Rx UE fails to decode a packet #A received in Rx UE’s SL DRX On duration and Tx UE retransmits the packet #A in the Rx UE’s extended SL DRX Active duration based on the HARQ NACK reception, if Rx UE fails to decode PSCCH/PSSCH of the retransmission (DTX case), TX UE considers the retransmission as successful because there is no HARQ ACK response, Then TX UE tries to transmit the next packet #B in the expected Rx UE’s extended Active duration based on the previous successful transmission. But Rx UE didn’t extend its SL DRX Active duration as it didn’t successfully receive the retransmitted packet, therefore again didn’t receive the packet #B, which in turn makes Tx UE mistake it as a successful transmission (due to no NACK transmission). At the Rx UE’s SL DRX On duration of the next SL DRX cycle, it’s possible that Tx UE transmits a new packet #C with HARQ process number and NDI as same as those for the packet #A transmission. In this case, Rx UE may tries HARQ combining both the packet #A and the packet #C, which totally destroys decoding.

One of the solution to the above situation is to use a PDB that was known from the QoS profile of the associated previous transmission. After decoding failure on the received packet, if Rx UE didn’t receive a retransmission packet until the PDB, Rx UE flushes the buffer for HARQ combining for the packet and wait for a new packet transmission. The other solution is to use a specific timer associated to the destination ID of the transmission. If Rx UE receives a new packet regardless of its success or failure in decoding, Rx UE starts to run the timer and if Rx UE didn’t receive any retransmission packet until the timer ends, Rx UE flushes the buffer for HARQ combining for the packet and wait for a new packet transmission.

**Observation 8. In SL DRX operation, DTX case may cause a wrong HARQ combining especially in groupcast option 2 (NACK-only HARQ feedback mode).**

**Proposal 12. The solution to avoid the wrong HARQ combining due to DTX case in SL DRX operation should be discussed in RAN2.**

----Quote from [R2-2110155](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110155.zip)----

**Question 10:** Do companies agree with Observation 8 “In SL DRX operation, DTX case may cause a wrong HARQ combining especially in groupcast option 2 (NACK-only HARQ feedback mode)?

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | Yes |  |
| InterDigital | Yes | We agree that this problem exists for NACK only groupcast HARQ feedback mode. |
| Apple | Yes | For NACK-only GC, this will happen. |
| Xiaomi | Yes | We understand this issue exists since R16. For example, RX UE may miss miss multiple TX UE’s transmission due to performing UL transmission. Also, no feedback is transmitted. Then wrong HARQ combining issue happens. |
| OPPO | No | This is not a specific issue in SL or DRX. Control channel missing (PDCCH for DL, and PSCCH for SL) can always happen, and NDI would help to avoid mixing of old/new data. The scenario raised here seems for the case where the NDI has been toggled twice and the packet N+1 is missed yet the packet of N and N+2 are received is quite a corner case in our view. |
| Nokia | No | We share Oppo’s view and fail to see any correspondence to SL-DRX as the issue is purely applicable to GC option 2. The issue raised is a corner case. |
| LG | Yes |  |
| Qualcomm | Yes | Yes, this may happen even without SL DRX. A corner case with low probability. |
| Intel | Yes |  |
| Spreadtrum | Yes |  |
| Lenovo | No with comments | Firstly, we think successful retransmission will not extend active time i.e. if a retransmission is deemed to be successfully decoded, it will not start inactivity timer, either not start retransmission timer, so for DTX case for retransmission, there has no mis-alignment for active time  Secondly, if Tx UE send a new packet on the same SL HARQ process, NDI will be toggled and Rx UE will not combine this new packet with last packet.  On the other hand, we identified another issue for GC in R2-2111065, that during retransmission timer, if Tx UE send new packet, those group members who has been correctly receive the last packet will not receive this new packet since no retransmission timer starts. So for GC, a new transmission may not be made when drx-HARQ-retransmission timer is running |
| ASUSTeK | Yes |  |
| vivo | Yes with comments | We also think this issue in not a SL DRX specific issue. SL DRX operation just puts the issue in a more serious situation. |
| NEC | Yes |  |
| CATT | Yes with comment | Although it will happen, but we think it is a rare case as analysed by OPPO. |

**Question 11:** Do companies agree with P12 to discuss the solution to avoid the wrong HARQ combining due to DTX case in SL DRX operation? If the answer is “yes”, please also provide considerations/views on the potential solutions.

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | Yes | The issue is mainly due to misaligned active state between UEs in case of GC and BC. The misalignment is mainly due to the conditional timers (inactivity timer, HARQ RTT, HARQ retransmission timer etc).  In our mind, the issue is relevant, however, the issue is rather complex. RAN2 shall aim for a simplified option, e.g., TX UE only allows to initiate an initial transmission during ON-duration.  Alternatively, RAN2 down-prioritizes the issue in Rel-17, which is also ok to us. |
| InterDigital | Yes | So far when discussing inactivity timer, we have assumed that addressing mismatch between TX and RX UE inactivity timers are not handled by specification in the TX UE. We think we should maintain this assumption in RAN2.  For this reason, we prefer the proposed solution in the paper “After decoding failure on the received packet, if Rx UE didn’t receive a retransmission packet until the PDB, Rx UE flushes the buffer for HARQ combining for the packet and wait for a new packet transmission.” |
| Apple | Yes | However, we feel the PDB-based solution may not work well that the RX UE may not know the exact PDB of the received packet as the QoS information for this packet is not available when packet is not fully decoded, even the L2 ID is not fully known yet. Also, the DRX cycle may also be smaller than the PDB.  I think the solution is better to let RX UE to not apply HARQ combining when SL-DRX is used for GC. |
| Xiaomi | No | As commented in Q10, this is not specific to DRX. Maybe we could discuss this issue in R16 corrections. |
| OPPO | No | As replied in Q10, we don’t think it is a critical issue to be solved. |
| Nokia | No | No need to consider this corner case here, especially as it is not related to SL DRX. |
| LG | Yes | One of the solution to the above situation is to use a PDB that was known from the QoS profile of the associated previous transmission. After decoding failure on the received packet, if Rx UE didn’t receive a retransmission packet until the PDB (PDB mapped to Standardized PQI), Rx UE flushes the buffer for HARQ combining for the packet and wait for a new packet transmission. The other solution is to use a specific timer associated to the destination ID of the transmission. If Rx UE receives a new packet regardless of its success or failure in decoding, Rx UE starts to run the timer and if Rx UE didn’t receive any retransmission packet until the timer ends, Rx UE flushes the buffer for HARQ combining for the packet and wait for a new packet transmission. |
| Qualcomm | No  (UE implementation) | This corner case is due to no differentiation between ACK and DTX for distance based HARQ feedback which is not limited to SL DRX. When to flush the buffer can be Rx UE’s implementation. |
| Intel | Yes | Agree with Ericsson that the issue arises from the (potential) misalignment in timers between the TX and RX UE. As far as solution goes, we also think a simple solution is preferred if companies want to specify it, i.e. when performing HARQ combining, RX UE shall take into account the PDB for the packet. |
| Spreadtrum | No | It is not a specific issue for SL DRX. |
| ASUSTeK | No | Agree with Nokia. |
| vivo | No | If it needs to be solved, we prefer a more general way e.g., discuss solutions in Rel-16 NR V2X or Rel-17 TEI. |
| NEC | No | Agree with Xiaomi and Spreadtrum that it is not a specific issue for SL DRX. |
| CATT | No |  |

## 3.6 [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip) P5

----Quote from [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip)----

Additional consideration on SL DRX on-duration timer and inactivity timer

At RAN2#115-e, it was agreed for GC/BC, SL DRX on-duration timer and inactivity timer are configured per QoS profile. On top of this agreement for GC, we think the number of group members should be considered in the determination of SL DRX on-duration timer and SL DRX inactivity timer lengths. For example, shorter SL DRX on-duration and inactivity timers for GC with the small group members while longer SL DRX on-duration and inactivity timers for GC with the big group members. Otherwise small SL DRX on-duration and inactivity timer would bring much collisions in the resource allocation for GC with the big group members or large SL DRX on-duration and inactivity timer would bring much power consumption for GC with the small group members. Note in Rel-16 SL, the scenario where the UE knows the number of group members in GC is already supported.

[Proposal 5]: For GC, number of group members needs to be considered in the determination of SL DRX on-duration and inactivity timers in the scenario where the UE knows it.

---Quote from [R2-2110938](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2110938.zip)----

**Question 12:** Do companies agree with P5 “For GC, number of group members needs to be considered in the determination of SL DRX on-duration and inactivity timers in the scenario where the UE knows it.”?

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | comments | Basically, the issue can be categorized as optimization/implementation. For the UEs in coverage, the gNB can provide configurations considering the load situation, i.e., the number of group members.  As a conclusion, we don’t think RAN2 shall spend efforts to discuss this issue. |
| InterDigital | No | While we agree that groupsize may be considered in determining the on duration, we think this provides advantages only for the cases where the groupsize is known, and therefore has limited applicability. Also, the ideal on duration is more impacted by congestion than the group size, since transmissions may be made from other services in the same on duration. |
| Apple | No | We do not think the onDuration length needs to be dynamically adjustable based on size of group. As long as one group member sent a message during the onDuration, the inactivity timer will be triggered, so all group members will stay awake for an extended period. From this perspective, there is no need to have different onDuraiton for different group size.  Then for inactivity timer, it is also true that the chance of “RX UE receiving a new SL transmission and extending the timer” scales with the number of members in the group, so the congestion probability and the timer extension probability both increase and can offset each other. We do not see a need to have thie inactivity timer scaleable with group size. |
| Xiaomi | comment | Agree with Ericsson |
| OPPO | No | After taking a long time to determine the configuration granularity of BC/GC, we tend to avoid introducing more dimension to make it more complicated in this late stage, if the baseline scheme can work. |
| Nokia | No | This is an optimization. How to determine the number of RX-Ues of the groupcast from a RX-UE point of view needs further discussion. |
| LG | No |  |
| Qualcomm | No | The number of UEs within connection based groupcast may not be necessarily linked to the channel congestion which mainly caused by the data volume (e.g., lots of packets to transmit) and channel condition (e.g., may retransmissions). If very member of the group transmits, it’ll take turn to do so which can be dynamically adapted by extending Inactivity timer. |
| Intel | No | We think this optimization is similar in nature to that discussed in Q4, we do not think it is needed using similar reasoning |
| Spreadtrum | No |  |
| Lenovo | Comments | We understand this proposal also intends to solve congestions issue in GC. As we commented for Question 4, we think congestion issue exist for groupcast, but even with different on duration values, still the congestion may happens according to our analysis in R2-2109724. Other solution e.g., one or more retransmissions at randomly distributed transmission opportunities may needed. |
| ASUSTeK | No |  |
| vivo | No | Basically we do not think the onDuration and inactivity length need to be dynamically adjusted based on size of group. Besides, we believe that the upper layer may update the QoS requirement accordingly if the group size changes. From this perspective, the current QoS based SL DRX configuration mechanism may be enough. |
| NEC | No |  |
| CATT | No | There is no need to decide the onduration and inactivity timer length considering there is inactivity timer which can extended the active time when there is data transmission requirement. |

## 3.7 [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip) P1-P2

----Quote from [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip)-----

# Configuration of On Duration

**Start of SL DRX On duration**

When SL TX UE operates in mode 1, it receives SL grant from gNB first, then initiates the SL transmission to SL RX UE. In general, it takes some time for SL TX UE to process the SL grant and data before the transmission. During this time, SL RX UE doesn’t need to monitor SL channel, as SL TX UE is unable to start transmission during the processing of SL grant and data. As shown in Figure 1, there is an Offset between the start of SL TX UE’s On duration on Uu and the start of SL RX UE’s On duration on SL. The value of the Offset depends on SL TX UE’s capability, i.e., how long it takes to process the SL grant and data. Starting the SL DRX On duration after the Offset from the Uu DRX On starting point would be beneficial to SL Rx UE for power saving.



**Figure 1 Offset between SL TX UE's On duration and SL RX UE's On duration**

***Observation 1: An offset between SL TX UE’s On duration start and SL RX UE’s On duration start is needed, which may be based on UE’s capability for processing a grant and preparing a transmission.***

***Proposal 1: An SL UE capability, representing the amount of time a UE needs to process SL grant and prepare data transmission, may be indicated by the UE to its serving gNB.***

***Length of SL DRX On duration***

It is possible that an SL TX UE unicasts with multiple SL RX UEs, and the SL RX UEs’ On durations may not be overlapped and should be aligned with SL TX UE’s On duration on Uu link.

Useful information for SL TX UE’s gNB to determine an appropriate On duration for SL may include:

* Traffic characteristics: packet size may be used to determine the length of the On duration. If a UE gets large packets for transmission, then it may require longer active time.
* QoS requirement: On duration should be selected based on QoS requirement.

***Observation 2: gNB may optimize SL RX UE’s SL DRX On duration based on traffic characteristics, QoS requirement.***

***Proposal 2: In addition to SL RX UE’s assistance information, SL traffic characteristics and associated QoS requirement are also indicated to the SL TX UE’s gNB for determining SL DRX On duration.***

----Quote from [R2-2111119](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111119.zip)-----

**Question 13:** Do companies agree with P1 “An SL UE capability, representing the amount of time a UE needs to process SL grant and prepare data transmission, may be indicated by the UE to its serving gNB.”?

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | No | This is an optimization issue, the additional gain would be rather marginal. |
| InterDigital | No | We do not think the power savings gains of this approach are significant enough to warrant introduction of such capability. |
| Apple | No | Agree with InterDigital and Ericsson |
| Xiaomi | No | We think this is optimization. |
| OPPO |  | We are not clear whether this P is specifically for SL-DRX or applicable to R16 SL UE as well? Is it to have a capability for network to derive the proper setting of in *sl-DCI-ToSL-Trans* 3\_0 format? If yes, we understand it has been clarified in R16?    Some clarification is needed before pursuing this. |
| Nokia | No | The processing time is not critical and negligible for start of DRX On-duration. |
| LG | No | Same view with Ericsson. This is an optimization issue. |
| Qualcomm | Comment | Response to OPPO: yes. |
| Intel | No | Agree with Ericsson |
| Spreadtrum | No |  |
| Lenovo | No | Agree with InterDigital and Ericsson |
| ASUSTeK | No |  |
| NEC | No | Same view with Nokia. |
| CATT | No | Agree with Ericsson. |

**Question 14:** Do companies agree with P2 “*In addition to SL RX UE’s assistance information, SL traffic characteristics and associated QoS requirement are also indicated to the SL TX UE’s gNB for determining SL DRX On duration.*”?

|  |  |  |
| --- | --- | --- |
| Company | Responses | Comments |
| Ericsson | yes | But TX UE can use the existing *SidelinkUEInformationNR* to report the information to the gNB. no additional spec change is needed. |
| InterDigital | See comment | We agree with Ericsson – there is no additional specification beyond the use of SidelinkUEInformation and UEAssistanceInformation |
| Apple | See comment | I think this is already reported even before SL RX UE’s DRX assistance information is received. |
| Xiaomi | Comment | In SUI, TX UE can already report the QoS profile of each destination. No spec impact is foreseen. |
| OPPO | No | The legacy SUI (carrying QoS attributive) and UAI report (carrying packet size) is enough to repot the QoS and traffic pattern to gNB, therefore no need for this proposal. |
| Nokia | No | As stated by all previous companies, SUI and UAI are sufficient to signal QoS information to TX-UE. |
| LG | See comment | Agree with Ericsson and OPPO. Legacy SUI and UAI is enough to report the QoS and traffic pattern to gNB. |
| Qualcomm | Comment | In addition to the QoS and traffic pattern, a Tx UE may indicate if it’s a periodic traffic or not which may be useful for determining SL DRX cycle length. |
| Intel | Comment | Agree that SUI and UAI can already provide this information to the gNB |
| Spreadtrum | No | Tx UE already reports the QoS profile in SUI and traffic pattern in UAI. |
| Lenovo | See comment | Share the view with other companies that no additional specification is needed |
| ASUSTeK | Comment | Agree with Ericsson. |
| NEC | No | Agree with other companies’ view that this is possible by utilizing legacy SUI and UAI. |
| CATT | Yes with comment | The current SUI/UAI already enough to support it. No spec impact is identified. |

# 4 Conclusion

TBD

# 5 References

[1] R2-2109722, “Discussion on DRX suspend/resume mechanism”, NEC

[2] R2-2109812, “Further issues on SL DRX”, Nokia, Nokia Shanghai Bell

[3] R2-2109937, “Remaining aspects on SL DRX Timers”, InterDigital

[4] R2-2110062, “Discussion on Remaining issues of SL DRX”, Apple

[5] R2-2110155, “Discussion on remaining issues and further consideration on SL DRX”, LG Electronics France

[6] R2-2110938, “Open issues on SL DRX operation in groupcast”, Samsung Research America

[7] R2-2111119, “Discussion on Uu DRX and SL DRX Alignment”, Qualcomm Finland RFFE Oy